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| EXAMINER |
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LAZORCIK, JASON L

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1791

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10/28/2008

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

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|------------------------------|--------------------------------------|------------------------------------|--|
| Office Action Summary | Application No. 10/780,863 | Applicant(s) HONG ET AL. | |
| | Examiner JASON L. LAZORCIK | Art Unit 1791 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 August 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4 and 6-9 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4 and 6-9 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|----------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>8/21/2008</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on August 21, 2008 has been entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1-2, 4, 6-7 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hwang et al. (J. Mater. Chem., 2001, 11, 1722-1725) in view of Smalley et. al. (J. Nanosci. Nanotech, 2003, V3 (1), 81-86).

As presented in the Official Action dated August 16, 2007 regarding Claim 1, the Hwang reference teaches:

1. Adding carbon nanotubes (CNTs) to an aqueous solution of cetyltrimethylammonium bromide which is read as dispersing carbon nanotubes in a dispersion medium (Pg. 1722, Column 1, Lines 38-40)
2. Sonicating the solution or "dispersion" from (1) above (Pg. 1722, Column 1, Lines 40)
3. Adding sodium silicate and sodium aluminate to the sonicated solution from (2) above which is understood as dispersing a water-soluble salt in the sonicated dispersion. (Pg. 1722, Column 1, Lines 42-44). Said sodium silicate and sodium aluminate are understood to be metal-based salts of the metals Silicon and Aluminum, respectively, and at least the sodium silicate is capable of being formed into a SiO₂ ceramic matrix prior to calcination.
4. Sonicating the solution or "dispersion" from (3) above (Pg. 1722, Column 1, Lines 44)
5. Placing the solution into an autoclave and heating at ~110°C to form a yellowish silicate powder followed by calcinations in air at 400°C to oxidatively remove surfactant molecules (Pg. 1722, Column 2, Lines 2-3). This disclosure is read in the immediate claim as drying and calcinating the sonicated dispersion of (4) where the water soluble salt or sodium

Art Unit: 1791

silicate forms a ceramic matrix of SiO₂ post-calcination. Steps 1-5 yields a ceramic nanocomposite powder referred to by the authors as SiO₂-CNT rods wherein the CNTs are homogeneously encapsulated by or "dispersed in" a SiO₂ ceramic matrix (Pg. 1724, Column 1, Lines 11-12).

6. The SiO₂-CNT rods from (5) are mixed with SiO₂ powder and pressed into a disc followed by calcination or "further drying" in air at 400°C and calcination in an N₂ atmosphere at 1050°C to form a final composite disc.

Hwang provides concluding observations regarding the calcined salt-CNT materials and the composite ceramic material produced by mixing and hot pressing a blend of the SiO₂-CNT material with SiO₂ powder. Specifically, Hwang discloses that "it can be deduced that the mechanical strength of the SiO₂-CNT glass rods is stronger than the interactions between the glass rods and the matrix" (pg 1725, col.1, lines 13-28). It follows from this disclosure that the CNTs in fact do form a chemical interaction or some form of "chemical bond", be it a relatively strong covalent type bond or a relatively weak type Van Der Waals type bonding interaction, with the ceramic matrix material as presently claimed in Applicants amended claim 1.

(I) Sonication the CNT dispersion for a period between 2 to 10 hours is obvious in view of the Smalley reference

As noted above, Hwang teaches a process of forming a carbon nanotube reinforced ceramic nanocomposite. As indicated by Applicant in the reply to Office

Art Unit: 1791

Action dated November 2, 2006, the Hwang reference teaches sonication of the CNT solution for 10 minutes but it fails to explicitly provide for an extended sonication period of between 2 and 10 hours. However, Hwang clearly indicates that a stable and homogeneous suspension is critical to the quality of the product derived from the disclosed process, and that said suspension is achieved through the sonication step.

Smalley et. al. (J. Nanosci. Nanotech, 2003, V3 (1), 81-86) teaches the relationship between sonication time and CNT dispersion in aqueous solution for time periods up to approximately 5 hours. With specific attention to the instant reference Figure 2, Smalley tracks the intensity of a spectral feature indicative of dispersion quality as a function of time under continual sonication. The reference teaches that dispersion quality increases at least through the first four hours of sonication. It is the Examiners position that optimization of the sonication time was a recognized result effective variable of the dispersion quality at the time of the invention and that said time period would have been optimized through routine experimentation by one of ordinary skill in the art.

More specifically, it would have been obvious to one of ordinary skill in the art at the time of the invention to sonicate the CNT dispersion for a time period up to at least 5 hours in an effort to provide a high quality dispersion of CNTs. A high quality dispersion would have been a routine goal for one of ordinary skill seeking to optimize the uniformity of the resultant ceramic composite, and a sonication period between 2 to 10 hours is a minor and obvious extension over the prior art.

(II) The Hwang Disclosed Dispersion Reads Upon the Composition of Applicants

Claimed Dispersion "Consisting Essentially Of" the Named Components

Applicant claims (see claim 1, lines 6-7) require that the water soluble salt "includes" metal-based salts capable of being formed into a ceramic matrix. Where the water soluble salt is claimed to broadly "include" a metal-based salt, said water soluble salt is not construed to be exclusive of additional and unnamed components.

Although the transitional phrase "consisting essentially of" is construed to limit the scope of a claim to the specified materials or steps "and those that do not materially affect the basic and novel characteristic(s)" of the claimed invention, In re Herz, 537 F.2d 549, 551-52, 190 USPQ 461, 463 (CCPA 1976), the composition of the "water soluble salt" is itself not construed to be particularly limited. Further, Applicant has failed to clearly delineate the basic and novel characteristics such that one may reasonably ascertain what materials are excluded from the claimed dispersion. In view of the foregoing, Applicants claimed dispersion composition of claim 1 is construed as equivalent to a fully open claim drafted in a "comprising" format.

Applicant was previously advised that Hwang teaches preparing a dispersion comprising carbon nanotubes, a water-soluble salt capable of being formed into a ceramic matrix (e.g. sodium silicate and/or sodium aluminate), a water soluble quaternary ammonium salt (e.g. C₁₆TAB bromide) or surfactant, and water. Where Applicants claimed water soluble salt is not construed to exclude additional

Art Unit: 1791

components, including *inter alia*, a water soluble quaternary ammonium salt or surfactant, the Prior Art dispersion is understood to read directly upon Applicants claimed dispersion “consisting essentially of” the named components. That is, the Examiner can construe no reason to suggest that incorporation of the C₁₆TAB surfactant or quaternary ammonium salt as a component of the water soluble salt “including” the named metal-based salt would in any manner violate the basic and novel characteristics of the claimed invention or that the C₁₆TAB component should otherwise be excluded from the claimed dispersion composition.

More importantly, Applicant is cautioned that claims drafted in “consisting essentially of” terms will be construed as equivalent to “comprising”, absent a clear indication in the specification or claims of what the basic and novel characteristics actually are; See, e.g., PPG, 156 F.3d at 1355, 48 USPQ2d at 1355. As noted in MPEP §2105, Applicant has the burden of showing that the introduction of additional steps or components would materially change the characteristics of applicant’s invention. In re De Lajarte, 337 F.2d 870, 143 USPQ 256 (CCPA 1964). See also Ex parte Hoffman, 12 USPQ2d 1061, 1063-64 (Bd. Pat. App. & Inter. 1989)

Claim 2 is obvious in the rejection of Claim 1 above wherein it was set forth that the CNT dispersion is an aqueous solution.

Claim 4 is obvious in light of the rejection of Claim 1 wherein a ceramic matrix of SiO₂ is from the group including silicon oxides.

Claim 6 is obvious in light of the rejection of Claim 1 above wherein the claimed drying temperature range of 80 to 100°C is understood to be encompassed by ~110°C or “approximately” 110°C.

Alternately if it is deemed that “approximately” 110°C fails to read upon the disclosed temperature range, it would be obvious to one of ordinary skill in the art, seeking to dry a dispersion, to perform said drying step within a temperature range suitable for evaporating the dispersion medium. In the immediate case wherein said dispersant is water with a normal boiling point of 100°C, drying said dispersant at approximately 110°C would obviously encompass drying the dispersant in the temperature range of 80°C to 100°C since the latter range would yield materially equivalent drying effect.

Regarding **Claim 7**, Hwang indicates that “the silicate powder” described in the rejection of Claim 1 above is calcined in air at 400°C to oxidatively remove surfactant molecules. Although the instant reference does not explicitly teach the calcinations in the temperature range of 300 to 350°C as claimed, it is the examiners position that one of ordinary skill in the art at the time of the invention would be fully capable of determining the appropriate calcination temperature for a given ceramic matrix material.

While the Examiner acknowledges that the prior art range does not explicitly overlap the claimed range, the prior art calcining temperature of 400°C would be recognized by one of ordinary skill as so near the prior art temperature range as to be patentably indistinct therefrom. More specifically, one of ordinary skill in the art would have found ample motivation to explore lower calcining temperatures in an effort to

Art Unit: 1791

reduce processing costs associated with manufacturing the ceramic composite material. Therefore absent any compelling and unexpected results showing to the contrary, claimed calcining temperature range of 300-350°C is held as a merely obvious extension over the prior art teachings.

With respect to **Claim 9**, the claim requires a calcinations temperature of 400oC or lower. Hwang indicates that “the silicate powder” described in the rejection of Claim 1 above is calcined in air at 400°C to oxidatively remove surfactant molecules. As such the Hwang process reads on the broad limitation of the claim which requires a calcination temperature of 400°C or lower. Further, where no distinction is drawn between the process of drying and the process of calcination, it is understood that the act of heating the silicate powder to the calcination temperature inherently requires traversing the claimed temperature range of 300 to 350oC. Since the primary solvent utilized by Hwang is water as indicated above, with a normal boiling point of 100oC, the act of heating the silicate powder through the temperature range of 300 to 350oC is understood to “further dry” said ceramic matrix.

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hwang (J. Mater. Chem., 2001, 11, 1722-1725) as applied to Claim 1 above and in further view of Chang (6,420,293).

Hwang teaches that the SiO₂-CNT powder is to be calcinated in an N₂ atmosphere at 1050°C which falls within the claimed temperature range of 400-1700°C. Hwang fails to explicitly set forth that the calcination of the ceramic matrix, requiring a calcination

Art Unit: 1791

temperature of 400°C or higher as indicated above, should be performed under a high vacuum as claimed. Chang teaches that “heating of carbon nanotube materials at elevated temperatures in an oxidizing environment typically results in chemical changes in the surface of the particles (Column 3, Lines 51-54) and specifically that “heating in air at 640°C results in the formation of carboxyl and carbonyl groups at the particle surface” (Column 3, Lines 57-59). Both the N₂ atmosphere and a high vacuum environment are commonly utilized and well appreciated in the art as non-oxidizing environments.

Processing under a high vacuum would be an obvious alternative for the nitrogen atmosphere since the Hwang process utilizes calcination temperatures of 1050°C and damage to the CNTs occurs at temperatures in excess of 640°C under oxidative environments as indicated by Chang. Therefore it would be obvious to one of ordinary skill in the art seeking to minimize said oxidative damage to substitute a high vacuum environment for the nitrogen atmosphere in the Hwang process since both nitrogen and high vacuum provide the requisite non-oxidative environments.

Response to Arguments

2. Applicant's arguments filed August 21, 2008 have been fully considered but they are not persuasive.

3. Argument #1 (pages 7-8):

4. Applicant alleges that the Hwang disclosed dispersion employs a detergent and therefore does not meet the requirements of the presently claimed dispersion as set forth in claim 1 "consisting essentially of" the named components.

Art Unit: 1791

5. Applicants arguments on this matter are not persuasive.

6. As noted above, Applicants claimed water-soluble salt is not construed a being particularly limited or exclusive of additional components. For the reasons set forth in greater detail above, Applicants present claim language is construed to be open-ended and in no manner exclusive of the C₁₆TAB component employed in the prior art dispersion.

7. Argument #2 (pages 8-11):

8. Applicant alleges that since Hwang does not teach sonication for an extended period of time (e.g. 2 to 10 hours) then said reference does not disclose the chemical bonding resulting from said extended sonication.

9. The Examiner is not persuaded.

10. Specifically, the noted rejection of claims is based upon the combined references to Hwang and Smalley under 35 U.S.C. §103(a) while Applicants arguments appear to be directed exclusively to the Hwang teaching. It follows, in response to Applicant's arguments against the references individually; one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

In addition, as noted in the Official Action dated February 21, 2008, Hwang teaches forming an intimate dispersion of materials wherein carbon nanotubes in physical contact with and dispersed throughout a ceramic matrix. One of ordinary skill in the art would reasonably expect at least a nominal chemical interaction between the

Art Unit: 1791

constituent materials of the composite, be it a relatively strong chemical interaction such as a covalent bond or alternately a relatively weak chemical interaction such as by Van Der Waals bonding forces. Such chemical bonding would be reasonably expected irrespective of an extended sonication period. In addition, where the Smalley reference provides clear motivation for extended sonication periods, Applicants claimed chemical bonding is understood to flow naturally from the process of the combined teachings.

Finally, since Applicant has provided no evidence on the record to rebut the Examiners position on this matter, it follows that that the instant allegations are held to be mere conjecture and attorney argument.

The Official policy regarding Attorney argument is clearly outlined in MPEP §2145 [R-3];

“Attorney argument is not evidence unless it is an admission, in which case, an examiner may use the admission in making a rejection. See MPEP § 2129 and § 2144.03 for a discussion of admissions as prior art. The arguments of counsel cannot take the place of evidence in the record. In re Schulze, 346 F.2d 600, 602, 145 USPQ 716, 718 (CCPA 1965); In re Geisler, 116 F.3d 1465, 43 USPQ2d 1362 (Fed. Cir. 1997) (“An assertion of what seems to follow from common experience is just attorney argument and not the kind of factual evidence that is required to rebut a prima facie case of obviousness.”). See MPEP § 716.01(c) for examples of attorney statements which are not evidence and which must be supported by an appropriate affidavit or declaration.

11. Argument #3 (page 12):

Art Unit: 1791

12. Applicant argues that Hwang does not teach formation of a ceramic powder.

13. Applicants arguments on this matter have been previously addressed in the Official Action dated February 21, 2008 (see particularly page 16) and therefore are not further addressed.

14. Argument #4 (page 12-13):

15. Applicant argues that the instant invention forms a bond between the water soluble salt and the carbon nanotubes by “a process of gradually converting the water-soluble salt into the Ceramic matrix through drying and calcination instead of polymerization”. To the extent that Applicant alleges some distinction between the prior art ceramic conversion process and that presently claimed, Applicant was previously advised that the Hwang process employs both drying and calcining steps in formation of a ceramic matrix. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

16. Argument #5 (page 13-15):

17. Applicant alleges additional benefits are derived by calcining the ceramic matrix under vacuum, namely the efficient removal of hydrated water.

18. Applicants’ argument on this matter has been carefully considered, but Applicant is advised that the instant argument does not constitute a proper rebuttal to the Examiners previously stated position on this issue. Specifically, although Applicant claims additional benefits from the claimed process, Applicant has failed to present any convincing showing to suggest why calcination under vacuum would not represent an

Art Unit: 1791

obvious variant of the prior art disclosed process. The mere fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JASON L. LAZORCIK whose telephone number is (571)272-2217. The examiner can normally be reached on Monday through Friday 8:30 am to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Griffin can be reached on (571) 272-1189. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Application/Control Number: 10/780,863
Art Unit: 1791

Page 15

/Jason L Lazorcik/
Examiner, Art Unit 1791